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Scaling of Nd:Glass pumped Ti:Sapphire Chirped Pulse Amplification (CPA) systems to 100 TW and beyond.

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Abstract

We report on progress in production of >10 J, <100 fs pulses from a Ti:Sapphire CPA system. Data is presented demonstrating energies of >1J, focussed intensities of >5x10 $^{19}W/cm^2$.

Summary

We have been working on the development of high energy, ultrashort pulse laser systems based on Chirped Pulse Amplification (CPA) in Ti:Sapphire pumped by Nd:YAG and Nd:Glass. These systems begin with the now standard "front end" consisting of a mode-locked Ti:Sapphire oscillator followed by a pulse stretcher, and a regenerative amplifier pumped by a commercially available frequency doubled Nd:YAG. The resulting mJ level pulses are then amplified to several hundred mJ in Ti:Sapphire amplifiers that are also pumped by commercially available Nd:YAG lasers. At this point the pulses can be compressed to the multi-TW level. Systems of this type

have become fairly common and even commercially available. However, the pump energy needed to further amplify to energies of several Joules, or even >10 J is beyond what is currently available as a standard commercial product.

Our solution to this problem is to use frequency doubled, flashlamp pumped, Nd:Glass lasers as pump sources for large Ti:Sapphire amplifiers. Glass lasers have been used for many years and the technology needed to produce tens and even hundreds of Joules of pump energy in a smooth spatial profile is very available and well understood. For this talk, we present results of our first glass pumped Ti:Sapphire amplifier. This system is capable of producing 100 fs pulses with energy in excess of 1J. The high spatial quality of this system is evident in the focal spot images which indicate near diffraction limited performance yielding peak intensities if $>5x10^{19}$ W/cm^2.

We will also discuss the present limitations in scaling of this type of system to higher energies. This will include a report on our progress in producing <100 fs pulses energies in excess of 10J.

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